

# **Final Project Report to the NYS IPM Program, Agricultural IPM 2000 – 2001**

## **Title:**

Management of Obliquebanded Leafroller Damage and Insecticide Resistance with a Biorational Insecticide Program

## **Project Leader(s):**

H. Reissig, R. Straub, and A. Agnello, Department of Entomology, NYSAES, Geneva, NY 14456

## **Cooperator(s):**

Richard Endres, Todd Furber, Ed and Seth Burnap, Lynoaken Farms, Glendale Farms,

## **Type of grant:**

Research

## **Project location(s):**

Wayne County, NY and Orleans County, NY

## **Abstract:**

This study showed that resistance to organophosphates remained relatively stable in the field populations of OBLR during the 3 years of the study, despite the absence of sprays of these materials. The control of OBLR in the soft pesticide programs was generally better than that obtained by growers in their standard pesticide treatments. However, adequate control of plum curculio was not obtained in most of the blocks and at the end of the study, damage was observed even in blocks that were completely free of this pest during the first season. These results showed that adequate control of the curculio cannot be maintained for multiple seasons without using special control sprays even in blocks that would not be considered to be at risk from this pest. This soft insecticide program did not provide adequate control of internal lepidoptera in some of the blocks for multiple seasons, although control of apple maggots was acceptable. Foliar pests such as tentiform leafminers, green apple aphids, white apple leafhoppers, and mites were not serious problems in the soft pesticide blocks. Tarnished plant

bug damage was generally similar in grower's standard programs and the soft pesticide blocks. Secondary pests, such as rosy apple aphids and the San Jose Scale were problems in some of the soft pesticide blocks. However, the overall insect damage in the standard and soft pesticide was fairly similar during all seasons of the 3 year study, except in one orchard, which suffered severe damage from curculio and internal lepidoptera. The costs of insecticides applied in the standard and soft pesticide programs were fairly similar.

## **Background and justification:**

Growers in areas severely infested with OBLR commonly apply 4-5 special sprays to control this pest throughout the season. Even in these orchards receiving multiple sprays, it is not uncommon for growers to suffer 5-10% fruit damage, which may result in revenue losses of several hundred dollars/ A. Projected fruit damage from OBLR could be as high as \$1.1 million dollars in commercial apple orchards in NY state that are treated with currently available insecticides. In addition to directly damaging fruit, OBLR infestations may also adversely affect the management of other pests in NY apple orchards. Recently, growers have begun to use multiple applications of esfenvalerate, which is highly toxic to *Typhlodromus pyri*, the most effective predaceous mite in commercial apple orchards in NY state, in orchards severely infested with OBLR. If *T. pyri* populations are reduced or disrupted in NY orchards, it will be impossible to establish biological control programs for the European red mite in the future and growers will be forced to use additional applications of acaricides, which will not only increase pesticide control costs, but will also increase the rate of development of ERM resistance to newly labeled acaricides.

Unlike certain types of arthropod pests such as mites, aphids, leafhoppers, leafminers, and tarnished plant bugs that tend to occur at damaging levels in any given commercial orchard only in certain seasons, OBLR tend to persist and reoccur in the same commercial orchards in localized areas year after year. Growers are unable to eliminate or even consistently reduce OBLR population levels and fruit damage from season to season in these chronically infested orchards, even by applying extensive chemical treatments of multiple classes of insecticides against all generations of the pest. This current practice of extensively treating OBLR with conventional insecticides is not effective in preventing the reoccurrence of severe infestations, and is gradually increasing levels of resistance to older materials as well as facilitating cross resistance to certain new types of chemistry. Therefore, it is imperative to attempt to develop new approaches that may mitigate the development and proliferation of insecticide resistance and also lead to the management of the pest at lower, more stable, sustainable levels in infested commercial orchards.

In contrast to the extremely high levels of OBLR populations currently existing in chronically infested commercial orchards treated with standard insecticide programs, OBLR are usually found in relatively low numbers in unsprayed apple trees and extensive fruit damage is uncommon. It is likely that natural enemies of leafrollers including parasitoids and various types of predaceous insects that would likely be killed by sprays of conventional insecticides may play an important role in regulating OBLR populations in natural habitats. Of course, a number of factors that cannot be manipulated in commercial orchards could also be responsible for reducing OBLR populations in unsprayed apple trees, including: competition from numerous other species of leafrollers and other types of caterpillars that are common in unsprayed habitats and poor condition of foliage because of low nutritional levels and damage from apple scab and mildew. Although only a limited amount of formal research has been done to determine if natural enemies of leafrollers can be conserved in commercial apple orchards with selective IPM-compatible insecticides, informal observations have shown that populations of OBLR have not declined from year to year in orchards that are continually treated with even minimal (1-3 sprays) of standard organophosphate insecticides such as

Imidan and Guthion to manage traditional pests such as plum curculio, codling moth, and apple maggots. Therefore, in this proposed research, we will eliminate all traditional sprays of organophosphate insecticides and other broad spectrum materials for several consecutive seasons to determine if this will allow natural enemies to increase sufficiently to gradually reduce re-occurring infestations of OBLR.

Another potential benefit that may be obtained from eliminating conventional insecticides from orchards for OBLR management is the reduction of larval resistance levels to older materials. Studies conducted by two research groups in Canada have shown that resistance of larvae to organophosphate insecticides is unstable in laboratory colonies of OBLR in the complete absence of selection pressure from insecticides. When laboratory colonies of OBLR that were highly resistant to organophosphate insecticides were reared continuously without exposure to insecticides, resistance levels to organophosphate insecticides declined substantially after 3-5 generations. If this same principle is applicable under field conditions, populations of OBLR should become substantially more susceptible to organophosphate insecticides, and perhaps other classes of older conventional materials, if selection pressure is reduced for 2-3 seasons.

## Objectives:

1. To determine if populations and fruit damage of OBLR will decline because of the effects of natural enemies (parasitoids and predators) in commercial apple orchards treated entirely with soft pesticides for several consecutive seasons.
2. To determine if resistance levels of OBLR to organophosphates and other classes of conventional pesticides will decline in commercial apple orchards treated entirely with soft pesticides for several consecutive seasons.

## Procedures:

These tests were conducted in 5 commercial apple orchards in Western NY that have traditionally been severely infested with OBLR. One plot (5-10A) was set up in each apple orchard, and an adjacent plot with identical varieties, tree size, spacing, and past history of insecticide treatment will be used as a standard treatment. Trees in the standard treatment received conventional pesticide treatments, but the experimental plot was treated with different IPM-compatible treatments of insecticides described in table 1.

Table 1. IPM-Compatible insecticide and acaricide treatments for management of OBLR and other arthropod pests of apples.

Pesticide	Application Strategy & Target Pest*
Apollo or Savey	Pink, European red mite (ERM)
Pyramite	Summer, applied at ERM Thresholds
Provado	Aphids, spotted tentiform leafminers, leafhoppers, applied at threshold levels after sampling
Dipel	Overwintering OBLR (petal fall), 1st Gen. codling moth according to model predictions (1-2 sprays).

Spinosad

Second Gen. CM spray according to model predictions, followed by 1-2 more sprays for control of the summer Gen. of OBLR and maggot as determined from trap

apple catches.

---

\* If necessary, border sprays of Imidan or Guthion will be applied at petal fall and as needed according to oviposition model predictions for control of the plum curculio.

All treatments in both the standard and experimental plots were applied by the cooperating growers. Plots were monitored either by the grower's consultants or personnel from the NYSAES to determine when treatments were necessary. These standard treatments and experimental plots were treated and monitored for 3 consecutive growing seasons.

The following parameters were measured during each growing season in both the standard and experimental blocks: (1) OBLR larval Density-Fruit clusters were monitored for overwintering OBLR larvae, and growing terminals were sampled for the summer generation of OBLR. (2) Fruit damage from the overwintering generation of OBLR and the summer generation of OBLR was monitored during the summer and at harvest. (3) Parasitism was monitored from samples of late instar larvae from the overwintering and summer generations of OBLR. (4) Susceptibility of OBLR larvae to Guthion and Lorsban was monitored from colonies of larvae established from each orchard during each season of the test. Colonies were established from overwintering larvae collected in the spring before bloom and, if possible, the F1 generation of larvae was bioassayed. Larval susceptibility was compared by exposing the larvae from different colonies to several monitoring dosages. In addition to rating fruit for OBLR damage at harvest, the fruit was also examined for injury from other insects to determine the overall efficacy of the OBLR management program against the entire fruit feeding complex.

## Results and discussion:

At the beginning of this study during the 1999 growing season, larvae from the 5 orchards in the blocks selected for the "soft" pesticide treatments were about 30-15X more resistant to azinphosmethyl and 3-4X more resistant to chlorpyrifos than larvae from the susceptible colony. OBLR larval populations declined substantially in all of the "soft" pesticide blocks during the second and third year of the study and it was difficult to obtain sufficient larvae to establish a colony from several of the research blocks. However, in those blocks from which larvae were bioassayed, levels of resistance to both materials remained fairly constant during the three years of the study, despite the absence of selection pressure from organophosphate applications in the "soft" pesticide blocks. For example, overwintering OBLR larvae that were bioassayed from 2 of the "soft" pesticide blocks during the beginning of 2001 growing season were about 20X more resistant to azinphosmethyl and 2-4X more resistant to chlorpyrifos than susceptible larvae.

During the initial year of the study in 1999, control of OBLR was slightly better in the "soft" pesticide plots than in the grower's standard blocks, but more than 5% of the fruit was damaged in most of the blocks. However, during the two remaining years of the trial, OBLR damage substantially declined and remained at fairly constant low levels of 1-3% average fruit damage. OBLR damage also declined in the grower's standard blocks during the 2000 and 2001 seasons, but control in these blocks was generally not as good as in the "soft" plots (Fig. 1 & 2).

Fig. 1. Total OBLR damage in soft pesticide plots, 1999-2001

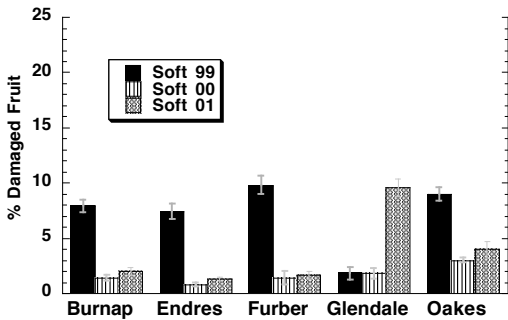
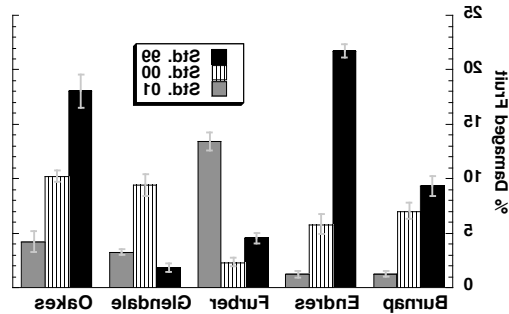


Fig. 2. Total OBLR damage in standard pesticide plots, 1999-2001



Secondary foliar pests such as mites, aphids, leafminers, and leafhoppers were generally not serious problems in the "soft" pesticide blocks during all three years of the study. However, some of the primary pests that cause fruit injury were not adequately controlled by the "soft" program. Plum curculio was one of the most serious pests in the "soft" blocks. Fruit injury from this pest steadily increased in the "soft" blocks during the second and third year of the study and damaged 10-15% of the fruit in 2 of the plots during the 2001 growing season. By the end of the third season of this study, curculio damage was found even in the "soft" blocks in which no damage had been detected during the initial season. Also, control of internal lepidoptera failed in one of the "soft" blocks, resulting in almost 30% fruit injury from this pest. Several of the other "soft" plots had traces of internal lepidoptera during the 2000 and 2001 growing seasons, although these low levels would probably not have been detected in normal fruit inspections. Apple maggots were not a serious problem in the "soft" plots, and only one damaged apple was observed in any of these plots during 3 years of harvest sampling. Levels of tarnished plant bugs in both the standard and soft plots were fairly similar during the study and usually an average of 1-3% of the apples in both treatments were damaged by this pest. Rosy apple aphids and scales were sporadic problems in the soft pesticide blocks, but damage in general was similar to that observed in the standard blocks. Although an economic analysis of data has not been completed, the costs of pesticides in the "soft" blocks and grower's standard plots appeared to be fairly similar.